Chapter 11. Colorado River Hydrologic Region

Setting

The Colorado River Hydrologic Region is located in the southeast portion of California (Figure 11-1 is a map and table of statistics that describe the region). The region includes all of Imperial County, approximately the eastern one-fourth of San Diego County, the eastern two-thirds of Riverside County, and about the southeast one-third of San Bernardino County. The Colorado River Region contains 12 percent of the State's area. It has many bowl-shaped valleys, broad alluvial fans, sandy washes, and hills and mountains. The Colorado River forms most of the region's eastern boundary and Mexico forms its southern boundary.

Owing to hydrologically-determined boundaries, the Colorado River region includes a portion of the Mojave Desert, primarily that part of the region within San Bernardino County and eastern Riverside County. The area to the east and south of the Mojave Desert area is a portion of the Sonoran Desert Elevations in the region mostly range from 1,000 to 3,000 feet in the Mojave Desert to less than 1,000 feet in the Coachella, Imperial, and Colorado River Valleys. Mountain peaks attain elevations from 6,000 to 7,000 feet. Many of the valleys contain playas, some quite large, including Bristol Dry Lake, which covers more than 50 square miles.

Climate

Nearly all of the Colorado River Region has a subtropical desert climate with hot summers and mostly mild winters, and the average annual rainfall is quite small. Average annual precipitation ranges from three to six inches, most of which occurs in the winter. However, summer storms do occur and can be significant in some years. Clear and sunny conditions typically prevail. The region receives from 85 to 90 percent of possible sunshine each year, the highest value in the United States. Winter maximum temperatures are mild, but summer temperatures are very hot.

Population

In 2000, the estimated population for the Region was about 606,000, which represented an increase of 31 percent from the 1990 population. More than half of the region's population resides in the Coachella Valley with most of the remaining located in Imperial Valley and in the corridor between the cities of Yucca Valley and Twenty-nine Palms along Highway 62.

Land Use

The region is a land of unequalled agricultural bounty with a growing urban sector, and large expanses of open, wild terrain. The U. S. Bureau of Land Management administers much of the Region, but many other entities have responsibilities.

Famous parks in the region include Joshua Tree National Park, the Mojave National Scenic Preserve, Anza-Borrego Desert State Park, and the Salton Sea and the Picacho State Recreation Areas. There are also several national recreation and wilderness areas, various preserves and wildlife refuges, and Indian reservations in the Region coming under some kind of preservation or managed status.

Despite the arid conditions, significant areas of agricultural and urban land uses exist in the region. The most prominent of these uses belongs to agriculture. More than $1.5 billion of agricultural commodities is produced in the region annually. Over 600,000 acres of land are farmed each year. The largest area of farming occurs in the Imperial Valley where over 450,000 acres of land are farmed annually. More than 93,000 acres are farmed in the Palo Verde Valley, followed by 60,000 in the Coachella Valley Smaller, but equally important agricultural operations are occurring in the Bard and Mohave Valleys.

A wide variety of crops are planted and harvested in the region, some of which are seasonally controlled. In terms of acres, alfalfa is the leading crop produced in the region. Almost 250,000 acres were cultivated in 2000, with 180,000 acres occurring in the Imperial Valley. Although constrained by climate, winter and spring vegetables, which includes lettuce, broccoli, onions, and melons, rank second in overall acres. Of the 150,000 acres harvested, almost 100,000 acres of the vegetables harvested in 2000 came from the Imperial Valley.

The Coachella and Bard Valleys are noteworthy for citrus and subtropical fruit production, especially dates. Also, the table grape industry in the Coachella Valley is well established.

The cattle industry in Imperial Valley is extremely important. It ranks as the highest-valued commodity produced in the Valley.

Other important crops grown in the region include wheat, sugar beets, and Sudan grass. Although less than now than its peak in the early 1980s, cotton is still grown in the region, mostly in the Palo Verde Valley.

Salton Sea

The present day Salton Sea was formed in 1905, when Colorado River water flowed through a break in a canal that had been constructed along the U.S./Mexican border to divert the river's flow to agricultural lands in the Imperial Valley. Until that break was repaired in 1907, the full flow of the river was diverted into the Salton Sink, a structural trough whose lowest point is about 278 feet below sea level. Over time, the Colorado River's course has altered several times. At times, the river discharged to the Gulf of California as it does today. At other times it flowed into the Salton Sink. Lake Cahuilla, the most recent of several prehistoric lakes to have occupied the Salton Sink, dried up some 300 years ago. In the past 2000 years, archaeological records indicate that the Colorado River actually headed northwest into the Salton Sink or Trough more often than it headed south into the Gulf of California. Over the long term, the Sea's elevation has gradually increased, going from a low on the order of 250 feet below sea level in the 1920s to its present level of about 226 feet below sea level.

It should be noted that multiple-cropping is prevalent in the Imperial, Palo Verde, Coachella, and Bard Valleys. In 2000, it was estimated that over 100,000 acres were double-cropped in the region.

Contrasting urban land uses co-exist in the region. In the Imperial and Palo Verde Valleys and the southern one-half of the Coachella Valley, small to moderately sized cities and communities exist which provide support for the surrounding agricultural activities. There are also numerous single-family residential dwellings scattered throughout the region. Many of the business and industrial sectors in the Cities of Blythe, Brawley and Indio provide this kind of support.

In the northern Coachella Valley, the urban area continues to expand between the Cities of Palm Springs and Indio. Other cities in this area include Palm Desert, Rancho Mirage, and La Quinta. This corridor is characterized by the presence of numerous extensively landscaped residential developments, expansion of

local business and consumer service centers, construction of luxury hotels and resort properties, and the operation of over 100 private and public golf courses. The expansion has been underway for several decades and does not appear to be subsiding. The expansion supports the region's recreation and tourism industry and the growing number of wealthy retirees and part-time residents.

Although smaller in scale, the urban area in the corridor between the Cities of El Centro and Imperial and within the City of Calexico has also been expanding. Business and consumer services there support consumers in the Imperial Valley and from the neighboring Mexicali Valley.

Water Supply and Use

About 90 percent of the region's water supply is from surface deliveries from the Colorado River (through the All-American and Coachella Canals, local diversions, and the Colorado River Aqueduct by means of an exchange for State Water Project (SWP) water). The Colorado River is an interstate (and international) river whose use is apportioned among the seven Colorado River Basin states by a complex body of statutes, decrees, and court decisions known collectively as the "Law of the River" (Table 11-1). Local surface water, groundwater, and the SWP (Table 11-3) provide the remainder of water to the region. Many of the alluvial valleys in the region are underlain by groundwater aquifers that are the sole source of water for local communities. Many of the alluvial valleys have poor quality water that is not suitable for potable use.

Table 11-1
Key Elements of the Law of the River

Document	Date	Main Purpose
Colorado River Compact	1922	The Upper Colorado River Basin and the Lower Colorado River Basin are each provided a basic apportionment of 7.5 maf annually of consumptive use. The Lower Basin is given the right to increase its consumptive use an additional 1 maf annually.
Boulder Canyon Project Act	1928	Authorized USBR to construct Boulder (Hoover) Dam and the All-American Canal (including the Coachella Canal), and gave congressional consent to the Colorado River Compact. Also provided that all users of Colorado River water must enter into a contract with USBR for use of the water.
California Limitation Act	1929	Limited California's share of the 7.5 maf annually apportioned to the Lower Basin to 4.4 maf annually, plus no more than half of any surplus waters.
Seven Party Agreement	1931	An agreement among seven California water agencies/districts to recommend to the Secretary of Interior how to divide use of California's apportionment among the California water users.
U.S. - Mexican Treaty	1944	Apportions Mexico a supply of 1.5 maf annually of Colorado River water except under surplus or extraordinary drought conditions.
U.S. Supreme Court Decree in *Arizona v. California, et al.*	1964	Apportions water from the mainstream of the Colorado River among the Lower Division states. When the Secretary determines that 7.5 maf of mainstream water is available, it is apportioned 2.8 maf to Arizona, 4.4 maf to California, and 0.3 maf to Nevada. Also quantifies tribal water rights for specified tribes, including 131,400 af for diversion in California.
Colorado River Basin Project Act	1968	Authorized construction of the Central Arizona Project and requires Secretary of the Interior to prepare long-range operating criteria for major Colorado River reservoirs.
U.S. Supreme Court Decree in *Arizona v. California, et al.*	1979	Quantifies Colorado River mainstream present perfected rights in the Lower Basin states.

Within California, the Seven Party Agreement (Table 11-2) established local agencies' apportionments of Colorado River water. The Secretary of the Interior apportions water to California water users according to the Seven Party Agreement. Water use that occurs within a state is charged to that state's allocation. Thus, federal water uses or uses associated with federal reserved rights (e.g., tribal water rights) must also be accommodated within California's basic apportionment of 4.4 maf/yr plus one-half of any available surplus water.

Table 11-2
Annual Apportionment of Use of Colorado River Water
(amounts represent consumptive use)

Interstate/International		
Upper Basin States (Wyoming, Utah, Colorado, New Mexico, small portion of Arizona)		7.5 maf
Lower Basin States (Arizona, Nevada, California)		7.5 maf
	Arizona	2.8 maf
	Nevada	0.3 maf
	California	4.4 maf
Republic of Mexico [a]		1.5 maf
a. Plus 200 taf of surplus water, when available. Water delivered to Mexico must meet specified salinity requirements. During an extraordinary drought, Mexico shares portionally with uses in the United States.		
Intrastate (Seven Party Agreement) [b]		
Priority 1	Palo Verde Irrigation District (based on area of 104,500 acres).	
Priority 2	Lands in California within USBR's Yuma Project (not to exceed 25,000 acres).	
Priority 3	Imperial Irrigation District and lands served from the All American Canal in Imperial and Coachella Valleys, and Palo Verde Irrigation District for use on 16,000 acres in the Lower Palo Verde Mesa.	
Priorities 1 through 3 collectively are not to exceed 3.85 maf/yr. There is no specified division of that amount among the three priorities. (Although this division was further defined in the Quantification Settlement Agreement.		
Priority 4	Metropolitan Water District of Southern California (MWDSC) for coastal plain of Southern California--550,000 af/yr.	
Priority 5	An additional 550,000 af/yr to MWDSC, and 112,000 af/yr for the City and County of San Diego [c].	
Priority 6	Imperial Irrigation District and lands served from the All-American Canal in Imperial and Coachella Valleys, and Palo Verde Irrigation District for use on 16,000 acres in the Lower Palo Verde Mesa, for a total not to exceed 300,000 af/yr.	
Total of Priorities 1 through 6 is 5.362 maf/yr.		
Priority 7	All remaining water available for use in California, for agricultural use in California's Colorado River Basin.	
b. Indian tribes and miscellaneous present perfected right holders that are not identified in California's Seven Party Agreement have the right to divert up to approximately 85 taf /yr (equating to about 50 taf/yr of consumptive use) within California's 4.4 maf basic apportionment. These users are presently consumptively using approximately 32 taf/yr (assuming about 25 taf/yr of unmeasured return flow).		
c. Subsequent to execution of the Seven Party Agreement, San Diego executed a separate agreement transferring its apportionment to MWDSC.		

Table 11-3
SWP Contractors in the Colorado River Region

Agency	Maximum Annual Amount (taf)	SWP Deliveries in 2000 (taf)
Coachella Valley Water District	23.1	42.3
Desert Water Agency	38.1	58.2
Mojave Water Agency (a)	75.8	11.2
San Gorgonio Pass Water Agency	17.3	0
a Maximum Annual Amounts include amounts for both the South Lahontan and Colorado River Regions; 7.3 taf of this amount is allocated to Colorado River Region.		

Neither Coachella Valley Water District (CVWD) nor Desert Water Agency (DWA) has facilities to take direct delivery of SWP water. Instead, both agencies have entered into exchange agreements with Metropolitan Water District of Southern California (MWDSC), whereby MWDSC releases water from its Colorado River Aqueduct into the Whitewater River for storage in the upper Coachella Valley groundwater basin. In exchange, MWDSC takes delivery of an equal amount of the agencies' SWP water. San Gorgonio Pass Water Agency (SGPWA), which serves the Banning-Beaumont area, also lacks the facilities to take delivery of SWP water into the portion of its service area which is within the Colorado River Region. However, SGPWA is currently delivering SWP water into the Santa Ana Planning Area of the South Coast Hydrologic Region. When Phase 2 of the East Branch Extension is completed, water will be delivered into the Colorado River Hydrologic Region; however, the Department is still planning for that Phase.

Groundwater provides about 7.5 percent of the water supply in normal years and about 7.7 percent in drought years (DWR 1998). Groundwater storage capacity is reported for 40 of the region’s 57 groundwater basins and is estimated to be more than 175 maf. Imperial Valley, the largest water-using area in the region, does not have significant supplies of usable groundwater.

In the Coachella Valley, groundwater levels have been declining since 1945. Imported water supplies from the Colorado River via the Coachella Canal have enabled decreased pumping of groundwater in the southeastern portion of the Valley and helped recharge the basin. In response, groundwater levels rose in this part of the Valley. However, in the 1980s, these levels began to decline again because of urban development and increased groundwater pumping.

Local water districts have been implementing programs to address the decline in groundwater levels. The move by CVWD and DWA to bring in SWP supplies was an important first step. In 1984, an agreement was reached among CVWD, DWA, and MWDSC that allowed for the advanced deliveries of Colorado River water supplies to the Coachella Valley during periods of high flows on the River. These supplies helped accelerate the pace of replenishment of the basin and provided water supplies for future uses.

Under the agreement, MWDSC was also permitted to bank approximately 600,000 acre-feet of supplies in the basin. When the need arises for these supplies, MWDSC will take its Colorado River water along with CVWD’s SWP allocations until the quantity of banked water supplies is exhausted.

In 2000, the estimated applied water demands for urban, agriculture, and the environment for the Colorado River Region were 4,775 taf. Most of the demands are for agriculture, approximately 85 percent. In 2000, the estimated applied water demand for agriculture was 4,071 taf.

Almost all of the agricultural demands in the Region occur in the three major agricultural areas described earlier, the Imperial, Palo Verde, and Coachella Valleys. The Imperial Valley, with over 500,000 acres of crops harvested each year, accounts for almost 70 percent of the total applied water demands for the region. In 2000, the applied demands for agriculture in the Imperial Valley were 2,911 taf.

Most of the agricultural demands are met with water supplies from the Colorado River. In the Coachella Valley, agricultural demands are met through a combination of Colorado River and groundwater supplies.

Urban applied water demands account for about 15 percent of the overall totals for the Colorado River Region. In 2000, urban demands were estimated to be 673 taf. Most of these demands occur in the Coachella Valley ; 527 taf in 2000 or almost 80 percent of the total applied water for the region. Existing housing and commercial uses have been augmented by large housing tracts with lavish landscaping, hotels, shopping centers, country clubs, golf courses, and polo fields. Landscape irrigation demands in the Coachella Valley are large because of the large expanse of turf grass and landscaping that have occurred in the last two decades.

Despite the availability of reliable and inexpensive water supplies, water districts and users are cognizant of the importance of implementing water conservation programs to effectively use and manage these supplies. For the past 50 years, the Imperial Irrigation District (IID), the region's largest water district, has implemented programs and completed projects designed to improve the efficiency of its water conveyance system. Under the IID/MWD Water Conservation Agreement, and Approval Agreement (December 1989), 15 new projects were completed including the construction of 3 lateral interceptors serving over 83,400 acres, the construction of 2 regulatory reservoirs and 4 interceptor reservoirs, concrete-lining of nearly 200 miles of lateral canals, and installation of new hardware and software to upgrade the existing telemetry equipment on its conveyance system (with a state-of-the-art Water Control Center). These infrastructure upgrades complimented existing IID programs such as the 13- and 21-Point Water Conservation Programs, irrigation scheduling and training services, and canal seepage recovery programs.

In addition to the improvements to its water conveyance system, the IID provides technical assistance to its agricultural customers through its Irrigation Management Services program Its most valued service has been the dissemination of information to farmers and irrigation personnel on methods to improve their irrigation operations. Moreover, the program is actively involved in the use and deployment of the following methodologies and instruments to improve irrigation efficiencies: level basin drip systems, level basin laser-leveling, irrigation scheduling, utilization of portable pump-back and tailwater return systems, salinity assessment, soil moisture sensors, and tailwater meters.

Excluding the water supply savings in the IID/MWD agreement, improvements to the water distribution and other water conservation techniques save over 600,000 acre-feet of supplies annually. Of this amount, the IID estimates that close to 400,000 acre-feet of the savings are attributable to the efforts by its agricultural customers.

The CVWD has also made important improvements to its water conveyance system. Water supplies are delivered to its agricultural customers through underground pipelines and are metered. The conveyance system is computerized which adds to the operational efficiency of the system. In addition to the

infrastructure improvements, CVWD provides technical services to its agricultural and residential customers on efficient irrigation management practices.

The districts have also examined their water operation policies and procedures. This review has resulted in modifications in the delivery procedures that have improved efficiencies and assisted local farmers in their attempts to implement irrigation scheduling activities.

For the PVID, telemetry controls have been installed for over 132 key control structures which has improved the management of water supplies in its canal system. Most of the fields in the Valley have been laser-leveled With the fields being flat, with no slope, tailwater flows from the fields are eliminated. All deliveries to the PVID's retail agricultural customers are measured.

PVID, in conjunction with the University of California Cooperative Extension and DWR, has installed three CIMIS stations to collect the necessary climatological data to help its agricultural water users in estimating crop ETAW and develop irrigation schedules. Water users are made aware of improvements in irrigation management and crop growing procedures through a local Progressive Farmers group.

To assist the CVWD, the PVID entered into an emergency six month fallowing program in 2003. Over 16,417 acres of farmland was idled and the unused water supplies, 41 taf, was transferred to CVWD.

The IID, PVID, and CVWD are signatories to the Memorandum of Understanding Regarding Efficient Water Management Practices by Agricultural Water Suppliers in California. By signing the MOU, the water districts reaffirmed and demonstrated their intentions to adopt and implement agricultural water management plans that would serve and benefit the agricultural water management activities within their service areas.

As mentioned earlier, growers in the major agricultural areas are utilizing the latest irrigation hardware and management techniques to increase both the efficiencies of their operations and crop yields. In the Imperial Valley, it is not uncommon to see drip, micro-sprinklers, and drip tape systems being utilized along with the traditional systems of furrow, basin, and hand-move sprinklers. The drip tape is most commonly used for high-market value crops such as vegetables. Drip and micro-sprinkler systems are commonly used to irrigate the citrus and subtropical fruit orchards; less than 1 percent of the acres (mainly date palms) are flood irrigated.

Most irrigation operations with vegetables and truck crops in Coachella Valley utilize drip tape and hand moved sprinklers. Some furrow irrigation is still being used. Citrus and subtropical fruit orchard irrigations are handled mainly with drip and micro-sprinklers; although flood or basin irrigation is still being used for mature date palms. Almost all the vineyards are being irrigated by some type of drip system; only a very small portion still rely on furrow irrigation. The use of overhead sprinkler systems is still a common sight in vineyards throughout the valley. They are used for frost protection and the inducement of vine dormancy for earlier fruit-sets.

Although most of the water conservation activities have been directed to agriculture, water districts in the Coachella Valley are providing technical assistance to the managers of the large landscaped areas, such as golf courses, to evaluate and offer suggestions for improvement for the irrigation hardware and operations at their facilities. The Coachella Valley Water District provides loans to its retail customers for irrigation

system upgrades. Desert Water Agency offers classes, in English and Spanish, to homeowners, property management personnel, and government and school personnel on irrigation efficiency strategies and tools.

The largest water body in the region is the Salton Sea, a saline lake with a concentration of total dissolved solids of approximately 45,000 mg/L, or 25 percent greater than that of ocean water. Most of the environmental water demands in the region are for the Sonny Bono Salton Sea National Wildlife Refuge, DFG Imperial Wildlife Area, and wetland areas on the shore of the Salton Sea. The Salton Sea ecosystem is considered a critical link on the international Pacific Flyway, providing wintering habitat for migratory birds, including some species whose diets are based exclusively on fish.

The following water balance table (Table 11-4) summarizes the detailed regional water accounting contained in the water portfolio at the end of this regional description. As shown in the table, imports make up a substantial portion of the water supply in the region. See Table 11-4**:** Colorado River Hydrological Region Water Balance Summary.

State of the Region

Challenges

Threatened or endangered fish species on the mainstem of the Colorado River include the Colorado pikeminnow, razorback sucker, humpback chub, and bonytail chub. Restoration actions to protect these fish may affect reservoir operation and streamflow in the mainstem and tributaries. Other species of concern in the basin include the bald eagle, Yuma clapper rail, black rail, southwestern willow flycatcher, yellow warbler, vermilion flycatcher, yellow-billed cuckoo, and Kanab ambersnail.

In 1993, the United States Fish and Wildlife Service (UFSWS) published a draft recovery implementation plan for endangered fish in the upper Colorado River Basin. The draft plan included protecting instream flows, restoring habitat, reducing impacts of introduced fish and sportsfish management, conserving genetic integrity, monitoring habitat and populations, and increasing public awareness of the role and importance of native fish.

Problems facing native fish in the mainstem Colorado River and its tributaries will not be easily resolved. For example, two fish species in most danger of extinction, the bonytail chub and razorback sucker, are not expected to survive in the

Salton Sea Ecosystem

The Salton Sea, a saline lake with a total dissolved solids of approximately 45,000 mg/L -- 25 percent greater than that of ocean water -- is California's largest (surface area) lake and has been famous for its sport fishing and other recreational uses. It is also a federally and state designated repository to receive and store agricultural, surface, and subsurface drainage waters from the Imperial and Coachella Valleys. Water imported from the Colorado River has created an irrigated agricultural ecosystem in the watershed. Consequently, wildlife and aquatic species, which are dependent upon habitat created by the discharge of agricultural return flows, are threatened by the salinity of the Sea, which is increasing at a rate of approximately one percent per year. The Sea's importance to wildlife has grown as approximately 95 percent of California's wetlands have disappeared because of changes in land use.

The Salton Sea ecosystem, including the Sonny Bono Salton Sea National Wildlife Refuge, is considered a critical link on the International Pacific Flyway for migratory birds. The amount of freshwater inflow that will be available to the Sea is considered uncertain due to water transfers within the United States and water conservation both in the United States and in Mexico.

wild. In recent years most stream and reservoir fisheries in the basin have been managed for non-native fish. These management practices have harmed residual populations of natives. Many native fish are readily propagated in hatcheries, and thus recovery programs include captive broodstock programs to maintain the species. Reestablishing wild populations from hatchery stocks will have to be managed in concert with programs to manage river habitat. For example, although 15 million juvenile razorback suckers were planted in Arizona streams from 1981-90, the majority of these planted fish were likely eaten by introduced predators. In 1994, the states of Colorado, Wyoming, and Utah reached an agreement with USFWS on protocols for stocking non-native fish in the Upper Basin. Stocking protocols are consistent with native fish recovery efforts. In a program, which began in 1989, USBR and other state and federal agencies have cooperated to capture, rear, and successfully reintroduce about 15,000 razorback sucker larvae in Lake Mohave.

Instream flows in the mainstem and key tributaries are being evaluated as components of native fish recovery efforts. State and federal agencies are conducting studies to estimate base flow and flushing flow needs for listed and sensitive species in various river reaches.

In the Lower Colorado River Basin, representatives of the three states, federal agencies, several Native American Tribes, and Colorado River water and power users are in the final stages of development of the Lower Colorado River Multi-Species Conservation Program (LCR MSCP). The LCR MSCP is intended to provide long-term compliance with the federal and California Endangered Species Acts.

The LCR MSCP is a 50-year program that would provide over 8,100 acres of high quality aquatic, wetland, and native broadleaf riparian habitat along the Lower Colorado River from Lake Mead to the Southerly International Boundary with Mexico. The restored and maintained habitats would provide ecological benefits and mitigate potential impacts to 26 covered species being addressed within the LCR MSCP. Some of the proposed habitat restoration may involve the conversion of existing agricultural lands to native riparian habitats, as well as removal of non-native salt cedar (tamarisk) and replacement with native broadleaf riparian habitat (e.g., cottonwood, willow, and mesquite, etc.).

Additionally, the LCR MSCP participants plan to rear and repatriate to the mainstream over 660,000 razorback suckers and 620,000 bonytail during the 50-year implementation period of the LCR MSCP. Over 360 acres of backwater habitats would be created along the Lower Colorado River to provide nursery habitat for juvenile native fish and additional wetland habitat for marsh species and migratory waterfowl.

California's Colorado River water and power using agencies and entities are participants in the LCR MSCP planning process. The LCR MSCP is expected to begin implementation in early 2005. The Bureau of Reclamation, in conjunction with representatives of the three states and the U.S. Fish and Wildlife Service, will be the agency primarily responsible for implementing the LCR MSCP during the 50-year period.

The Salton Sea, with its increasing salinity, selenium, and eutrophication, is the primary focus of international water quality issues in the Colorado River region. The largest sources of the Sea's inflow are the New and Alamo Rivers and the Imperial Valley Agriculture Drains, which contribute pesticides, nutrients, selenium, and silt. These contamination problems in particular present threats to migrating birds on the Pacific Flyway. The most polluted river in the U.S., the New River actually originates in Mexicali

(Mexico), flows across the International Boundary, through the city of Calexico, and then northward, emptying into the Salton Sea. It conveys urban runoff, untreated and partially treated municipal and industrial wastes, and agricultural runoff from the Mexicali and Imperial Valleys. These pollution sources contribute pesticides, pathogens, silt, nutrients, trash, and VOCs (primarily from Mexican industry) to the Sea. The Alamo River, which originates just two miles south of the border and also flows northward to the Salton Sea, consists mainly of agricultural return flows from the Imperial Valley. Pathogens are also problematic in the Palo Verde Outfall Drain, which drains back into the river, and the Coachella Valley Stormwater Channel, which drains to the Sea. At some times of the year, nutrient loading to the Sea supports large algal blooms that contribute to odors, as well as low dissolved oxygen levels that adversely affect fisheries. Selenium is a more recent constituent of interest, potentially affecting fish and wildlife. Water conservation measures to facilitate water transfers to the South Coast could dramatically increase the levels of selenium, which is primarily from the Colorado River and subsurface (tile) drainage discharges to the Sea.

The relatively saline Colorado River provides irrigation and domestic water to much of southern California. Of recent human health concern are the presence of low levels of perchlorate in the Colorado River (from the Las Vegas Wash), and hexavalent chromium at very high levels in wells at Needles near the River. The Colorado's perchlorate contamination originates at a site in the Las Vegas Wash and is the nation's largest. Septic systems at recreational areas along the Colorado are also a concern for domestic and recreational water uses. Other important water quality issues in this region include increasing levels of salinity, nitrates and other substances in groundwater associated with animal feeding and dairy operations and septic tank systems, especially in the Desert Hot Springs area and in the Cathedral City Cove area. In the Coachella Valley, nitrates have restricted the use of several domestic water supply wells.

To address the issue of declining groundwater levels, CVWD and DWA have prepared a groundwater management plan for the lower valley. They have considered alternatives that include basin adjudication, water conservation, water recycling, and direct or in lieu recharge with water imported from the Colorado River or from the SWP. The plan was completed in 2002.

As a result of the 1964 U.S. Supreme Court decree in Arizona v. California, California's basic apportionment of Colorado River water was quantified and five lower Colorado River Indian Tribes were awarded 905 taf of annual diversions, 131 taf of which were allocated for diversion in and chargeable to California pursuant to a later supplemental decree.

In 1978, the tribes asked the Court to grant them additional water rights, alleging that the U.S. failed to claim a sufficient amount of irrigable acreage, called omitted lands, in the earlier litigation. The tribes also raised claims called boundary land claims for more water based on allegedly larger reservation boundaries than had been assumed by the court in its initial award. In 1982, the Special Master appointed by the Supreme Court to hear these claims recommended that additional water rights be granted to the Indian tribes. In 1983, however, the U. S. Supreme Court rejected the claims for omitted lands from further consideration and ruled that the claims for boundary lands could not be resolved until disputed boundaries were finally determined.

Three of the five tribes – the Fort Mojave Indian Tribe, the Fort Yuma-Quechan Indian Tribe, and the Colorado River Indian Tribe – are pursuing additional water rights related to the boundary lands claims.

A settlement has been reached on the claim of the Fort Mojave Indian Tribe, and a settlement may soon be reached on the claim of the Colorado River Indian Tribe. Both settlements would then be presented to the Special Master. The claim of the Fort Yuma-Quechan Indian Tribe has been rejected by the Special Master on the grounds that any such claim was necessarily disposed of as part of a Court of Claims settlement entered into by the tribe in a related matter in the mid1980s. As with all claims to water from the mainstem of the Colorado River and any determination by the Special Master, only the U.S. Supreme Court itself can make the final ruling.

If both the Fort Mojave and the Colorado River Indian Tribe settlements were approved, the tribes would receive water rights in addition to the amounts granted them in the 1964 decree.

Accomplishments

There have been several large-scale water conservation actions involving Colorado River water users, as shown in Table 11-4.

Table 11-4
Existing Colorado River Region Water Conservation Actions

Year	Action	Participants	Comments/Status	Estimated Savings
1980	Line 49 miles of Coachella Branch of All American Canal	USBR, CVWD, MWDSC	Project completed.	132 taf/yr
1988	IID distribution system improvements and on-farm water management actions	IID, MWDSC	Multi-year agreement, extends into 2033. Projects MWDSC has funded include canal lining, regulatory reservoir and spill interceptor canal construction, tailwater return systems, non-leak gates, 12-hour delivery of water, drip irrigation systems, linear-move irrigation systems, and system automation. MWDSC has funded over $150 million for conservation program costs through 1997.	107 taf/yr in 1998
1992	Groundwater banking in Arizona	MWDSC, CAWCD, SNWA	Test program to bank up to 300 taf.	MWDSC and SNWA have stored 139 taf in Arizona groundwater basins.
1992	PVID land fallowing	PVID, MWDSC	Project completed. Two-year land fallowing test program. Covered 20,215 acres in PVID.MWDSC paid $25 million to farmers over a two-year period.	Total of 186 taf was made available from the program, although the water was subsequently released from Lake Mead when flood control releases were made from the reservoir.
1995	Partnership agreement	USBR, CVWD	Provides, among other things, for studies to optimize reasonable beneficial use of water in the district.	N/A
1998	Water transfer agreement	IID, SDCWA	Initial terms of 45 years and renewal terms of 30 years.	10 taf/yr in 2003 to 200 taf/yr in 2022 and thereafter.
2003	Land lease agreement	PVID, CVWD	PVID conserved and transferred water supplies to CVWD.	40.6 taf in 2003.
2004	Land fallowing	PVID, MWDSC	35-year land fallowing program.	Proposal for PVID to make up to 111 taf/yr of water supplies available to MWDSC.

Relationship with Other Regions

Although the facilities to deliver SWP water supplies to the region have yet to be constructed, CVWD and DWA receive their annual allocations of SWP water through an exchange agreement with the South Coast Region's largest water wholesale agency, MWDSC. These districts are also participants in another agreement that delivers and stores water supplies from the Colorado River in the Coachella Valley's largest groundwater basin during periods of high flows.

Water districts in both regions are also cooperating in water conservation and land fallowing programs. The 1988 IID/MWDSC Water Conservation Agreement resulted in the conservation of water supplies from the construction of new facilities, water system automation, and the implementation of technical

assistance programs for farmers within the IID water service area. The conserved water is delivered to MWDSC.

MWDSC and PVID are negotiating the terms for a 35-year land fallowing, crop rotation, and water supply agreement. A certain percentage of lands normally farmed in the Palo Verde Valley would be fallowed each year. Water supplies for these lands would be delivered to MWDSC. Some of these supplies would be used to facilitate the transfer agreement between SDCWA and the IID.

Looking to the Future

During 2002 and 2003, the California Colorado River water agencies, working through the Colorado River Board of California, have been developing a proposal for discussion with the other basin states to illustrate how, over time, California would reduce its use to the basic apportionment of 4.4 maf/yr. A draft of the proposal, prepared by the Colorado River Board is entitled "California's Colorado River Water Use Plan" (Water Use Plan), has been shared with the other six basin states. The last official draft of the document was May 11, 2000. Efforts are currently underway to update the document.

As currently formulated, the Water Use Plan would be implemented in two phases. The first phase (between the present and 2010 or 2015) includes improved system and reservoir management, such as the interim surplus guidelines and canal lining, to reduce California's Colorado River water use to about 4.6 to 4.7 maf/yr. The second phase would implement additional measures to reduce California's use to its basic annual 4.4 maf apportionment in those years when neither surplus water nor other states' unused apportionments were available. One of the fundamental assumptions made in the plan is that MWDSC's Colorado River Aqueduct will be kept full, by making water transfers from agricultural users in the Colorado River Hydrologic Region to urban water users in the South Coast Hydrologic Region.

The agricultural water purveyors in the region (IID, PVID, CVWD, and Bard Water District) will continue to implement Efficient Water Management Practices. Water districts in the Coachella Valley will continue with their efforts to provide technical assistance to the managers of large landscape areas to help improve the efficiencies of irrigation operations.

CVWD will continue to work with DWA to address the declining water levels in the Coachella Valley’s largest groundwater basin, the Indio sub-basin. They are operating an active groundwater recharge program for the upper end of the Coachella Valley (generally, the urbanized part of the valley). CVWD recharges groundwater with imported Colorado River supplies and with Whitewater River flows using percolation ponds. CVWD and DWA levy extraction fees on larger groundwater users in the upper Coachella Valley.

With support from the Quechan Indian Reservation, Bard Water District (BWD) is undertaking an $8 million project for capital improvements on the Reservation Division of the U.S. Bureau of Reclamation's Yuma Project. This improvement project is in large part funded by a $4 million matching grant from the North American Development Bank. The Quechan Indian Reservation contributed $2 million of the matching funds and $2 million were raised by BWD customers BWD is rehabilitating approximately 10 miles of earthen canals with concrete lining and pipeline in 2004 and an additional 10 miles are to be rehabilitated in 2005 BWD will also be replacing over 100 irrigation gates and structures. These

improvements will greatly increase the effectiveness of its system by reducing water losses from seepage and evaporation.

Over the years, the Bureau of Reclamation and others have considered potential solutions to stabilize the Salton Sea's salinity and elevation. Most recently, the Salton Sea Authority has been performing appraisal level evaluations of some of the frequently suggested alternatives, such as large scale pump-in, pump-out pipelines to the Pacific Ocean. The Authority is currently investigating integrated strategies where a smaller, lower salinity lake with a stable water surface would be coupled with treatment/desalination of some brackish inflows. The treated water could then be sold or could be part of a water transfer that would help fund the project.

Key Elements of California's Colorado River Quantification Settlement Agreement

The California Colorado River Quantification Settlement Agreement will have the following effects:

- Have California adopt specific, incremental steps to gradually reduce its use of Colorado River water over the next 14 years to its basic annual apportionment of 4.4 million acre feet.
- Provide Arizona, Colorado, Nevada, New Mexico, Utah and Wyoming with certainty on use of the river, allowing them to take their full apportionments to meet future water needs.
- Permits the utilization of interim surplus water stored in Lake Mead.
- Transfer as much as 30 million acre-feet of water from farms to cities in Southern California over the 75-year term of the deal.
- Settle a lawsuit between the Imperial Irrigation District and the Interior Department, alleging that the District was wasting water.
- Launch an ambitious plan to reduce rising salinity in the Salton Sea, a massive, agricultural sump straddling Riverside and Imperial counties that is an important stopping point for migratory birds.
- Provide for $163 million to offset the environmental impacts of the water transfer in the arid Imperial Valley and help fund the cost of restoring the Salton Sea.
- Fund a $200 million project to line, with concrete, the earthen All-American Canal, which delivers Colorado River water to the Imperial Valley, with concrete. Water conserved by reducing seepage will be sold to San Diego.
- Quantify, for the first time, the total Colorado River apportionments among water districts within California.

Adapted from The Associated Press. "Key elements of Colorado River water deal." October 17, 2003.

The Colorado River Quantification Settlement Agreement (QSA), finalized in October 2003, outlines key elements for California to operate within its basic annual allotment of 4.4 maf from the Colorado River.

Water Portfolios for Water Years 1998, 2000, and 2001

Above average rainfall occurred during Water Year 1998. For Water Years 2000 and 2001, rainfall totals were below average; 2000 could be considered a dry year. In Water Year 1998, rainfall totals averaged 176 percent above average for the NWS station in Blythe, 104 percent of average for the El Centro 2 SSW station and 108 for Palm Springs.

Water Year 2000 was very dry. Rainfall totals measured by the Blythe station for the year were only 17 percent of average; for El Centro, 10 percent of normal; and for Palm Springs, 35 percent of normal. Conditions improved slightly for Water Year 2001. The Blythe station measured rainfall that was 120 percent of normal. For El Centro, it was 78 percent of normal and for Palm Springs, it was 74 percent.

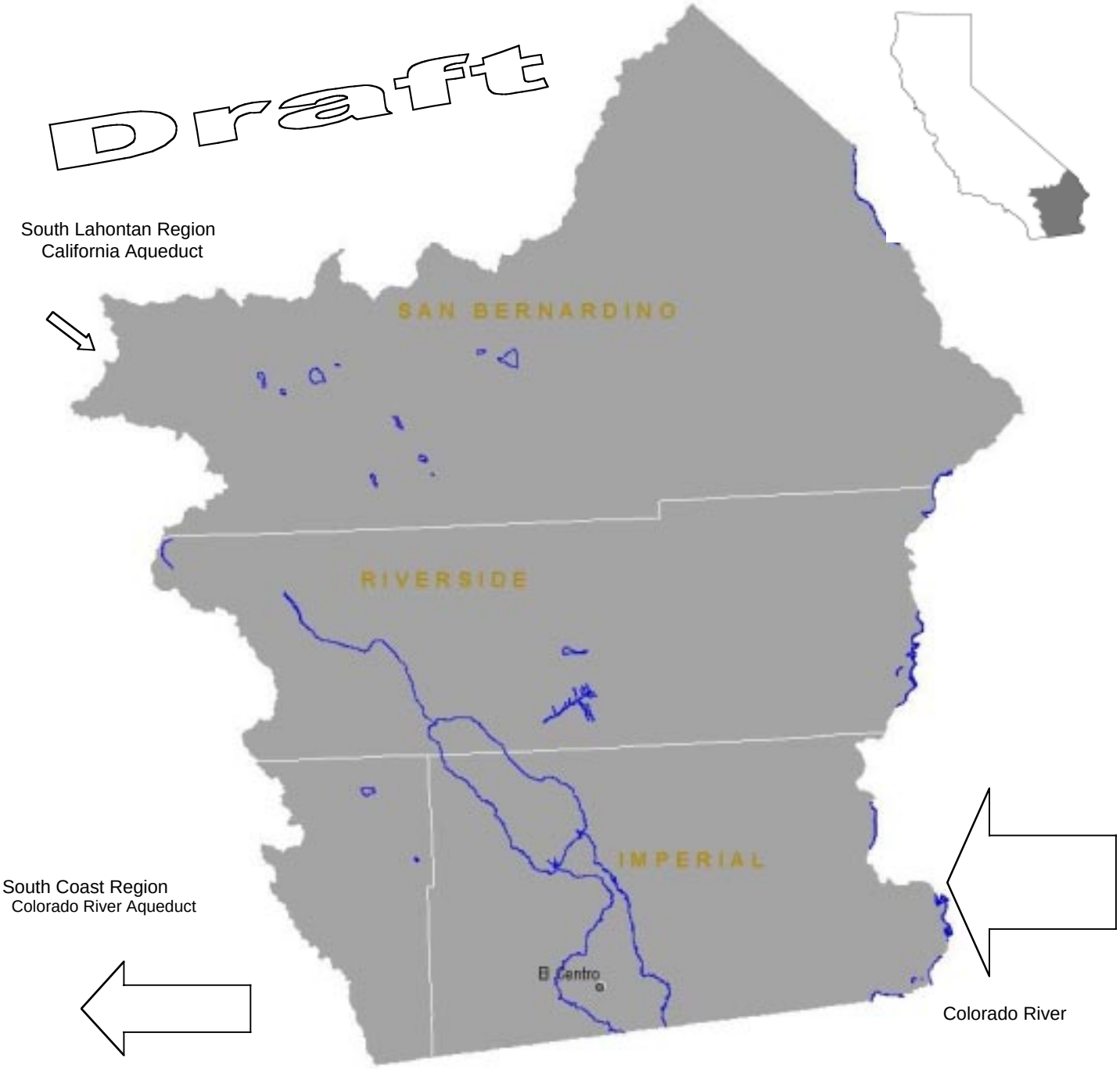
Despite the climatological conditions, demands for water supplies by the region's urban and agricultural users and the environment did not exhibit any large fluctuations during the period. The total applied water demand for 1998 was 4,604 taf. For 2000, the demands increased slightly to 4,775 taf, and for 2001, it was 4,668 taf.

Minor reductions in the irrigated crop acres occurred from 1998 to 2000, followed by a slight increase for 2001. Totals for the region were 761,760 acres in 1998, 731,890 acres for 2000, and 739,830 for 2001. Noticeable declines were noted for the irrigated grains and other field crop categories. A steady increase was noted for the vegetables crops classified in the Other Truck category.

Sources of Information

- Water Quality Control Plan, Regional Water Quality Control Board
- Watershed Management Initiative Chapter, Regional Water Quality Control Board
- 2002 California 305(b) Report on Water Quality, State Water Resources Control Board
- Bulletin 118 (Draft), California's Groundwater, Update 2003, Department of Water Resources
- Nonpoint Source Program Strategy and Implementation Plan, 1998-2013, State Water Resources Control Board, California Coastal Commission, January 2000
- Strategic Plan, State Water Resources Control Board, Regional Water Quality Control Boards, November 15, 2001
- Colorado River Board of California
- Western Regional Climate Center website.
- Metropolitan Water District of Southern California.
- Colorado River Basin Regional Water Quality Control Board.
- California Department of Health Services (DHS), "Drinking Water Standards".
- DHS. "Chemical Contaminants in Drinking Water". July 3, 2003.
- DHS. "Drinking Water Action Level, Chemicals with Recent Detections". June 12, 2003
- DHS. "Drinking Water Action Levels, Historic Action Levels and Action Levels for Contaminants Detected Infrequently". June 30, 2003.
- DHS. "Specific Contaminants of Current Interest: arsenic, chromium-6, manganese, methyl tertiary butyl ether (MTBE), N-nitrosodimethylamine (NDMA), perchlorate, 1, 2, 3-trichloropropane.
- DHS. "Perchlorate in California Drinking Water: Status of Regulations and Monitoring". July 2, 2003.
- DHS. "Chromium-6 in Drinking Water: Background Information". April 8, 2003.
- DHS. "Chromium-6 in Drinking Water: Regulation and Monitoring Update". July 16, 2003.
- California Environmental Protection Agency website. List of Drinking Water Contaminants and MCLs.
- California Environmental Protection Agency website. Drinking Water Contaminant Candidate List.
- California Environmental Protection Agency website. Regulations and Guidance.
- U. S. Geological Survey National Water Quality Assessment Program.
- U. S. Geological Survey online publications.
- Coachella Valley Water District
- Imperial Irrigation District
- Palo Verde Irrigation District
- U. S. Bureau of Reclamation
- Salton Sea Authority
- U. S. Fish and Wildlife Service
- Chemical & Engineering News, "Rocket-Fueled River<" August 18, 2003.
- Groundwater Resources Association of California. "Perchlorate and NDMA: Rocket Fuel Contaminants a Serious Challenge to Drinking Water Suppliers". News release. April 4, 2002.
- State Water Resources Control Board. "Perchlorate Contamination of California's Groundwater Supplies".
- Presentation by staff of staff of the State Water Resources Control Board and staff of the Department of Toxic Substances Control". 2003.
- U. S. Environmental Protection Agency. Ground Water & Drinking Water website. "Perchlorate". January 23, 2003.
- U. S. Environmental Protection Agency. "Perchlorate Environmental Contamination: Toxicological Review and Risk Characterization (External Review Draft)". 2002.
- Agency for Toxic Substances and Disease Registry. "Toxicological Profile for Chromium". May 25, 2001.
- The Associated Press. "Key elements of Colorado River water deal." October 17, 2003.
- Lower Colorado River Multi-Species Conservation Program Web site. http://www.lcrmscp.org/

Figure 11-1
Colorado River Region



Some Statistics

- Area - 19,962 square miles (12.6% of State)
- Average annual precipitation – 5.7 inches
- Year 2000 population - 606,090
- 2030 projected population –
- Total reservoir storage capacity - 620 TAF
- 2000 irrigated agriculture - 628,550 acres

Table 11-5
Colorado River Region Water Balance Summary – TAF

Water Entering the Region – Water Leaving the Region = Storage Changes in Region

	1998 (wet)	2000 (average)	2001 (dry)
Water Entering the Region			
Precipitation	9,455	3,034	4,770
Inflow from Mexico	182	166	155
Inflow from Colorado River	3,905	4,053	3,947
Imports from Other Regions	5,143	5,449	5,193
Total	**18,685**	**12,702**	**14,065**
Water Leaving the Region			
Consumptive Use of Applied Water * (Ag, M&I, Wetlands)	2,795	2,940	2,831
Outflow to Oregon/Nevada/Mexico	0	0	0
Exports to Other Regions	1,081	1,296	1,202
Statutory Required Outflow to Salt Sink	0	0	0
Additional Outflow to Salt Sink	1,273	1,279	1,245
Evaporation, Evapotranspiration of Native Vegetation, Groundwater Subsurface Outflows, Natural and Incidental Runoff, Ag Effective Precipitation & Other Outflows	13,609	7,395	8,987
Total	**18,758**	**12,910**	**14,265**
Storage Changes in the Region [+] Water added to storage [–] Water removed from storage			
Change in Surface Reservoir Storage	-15	-19	1
Change in Groundwater Storage **	-58	-189	-201
Total	**-73**	**-208**	**-200**

Applied Water * (compare with Consumptive Use)	4,132	4,346	4,290

* Definition - Consumptive use is the amount of applied water used and no longer available as a source of supply. Applied water is greater than consumptive use because it includes consumptive use, reuse, and outflows.

**Footnote for change in Groundwater Storage

Change in Groundwater Storage is based upon best available information. Basins in the north part of the State (North Coast, San Francisco, Sacramento River and North Lahontan Regions and parts of Central Coast and San Joaquin River Regions) have been modeled – spring 1997 to spring 1998 for the 1998 water year and spring 1999 to spring 2000 for the 2000 water year. All other regions and year 2001 were calculated using the following equation:

GW change in storage =
intentional recharge + deep percolation of applied water + conveyance deep percolation – withdrawals

This equation does not include the unknown factors such as natural recharge and subsurface inflow and outflow.

Table 11-6
Water Portfolios for Water Years 1998, 2000 and 2001

Category	Description	Colorado River 1998 (TAF)				Colorado River 2000 (TAF)				Colorado River 2001 (TAF)				Data
Inputs:		Water Portfolio	Applied Water	Net Water	Depletion	Water Portfolio	Applied Water	Net Water	Depletion	Water Portfolio	Applied Water	Net Water	Depletion	**Detail**
1	Colorado River Deliveries		3,904.9				4,052.8				3,946.9			PSA/DAU
2	Total Desalination		-				-				-			PSA/DAU
3	Water from Refineries		-				-				-			PSA/DAU
4a	Inflow From Oregon		-				-				-			PSA/DAU
b	Inflow From Mexico		182.4				165.6				154.7			PSA/DAU
5	Precipitation	9,454.8				3,033.9				4,769.9				REGION
6a	Runoff - Natural	N/A				N/A				N/A				REGION
b	Runoff - Incidental	N/A				N/A				N/A				REGION
7	Total Groundwater Natural Recharge	N/A				N/A				N/A				REGION
8	Groundwater Subsurface Inflow	N/A				N/A				N/A				REGION
9	Local Deliveries		6.6				6.3				4.0			PSA/DAU
10	Local Imports		-				-				-			PSA/DAU
11a	Central Valley Project :: Base Deliveries		-				-				-			PSA/DAU
b	Central Valley Project :: Project Deliveries		-				-				-			PSA/DAU
12	Other Federal Deliveries		-				-				-			PSA/DAU
13	State Water Project Deliveries		156.4				100.6				43.9			PSA/DAU
14a	Water Transfers - Regional		-				-				-			PSA/DAU
b	Water Transfers - Imported		-				-				-			PSA/DAU
15a	Releases for Delta Outflow - CVP		-				-				-			REGION
b	Releases for Delta Outflow - SWP		-				-				-			REGION
c	Instream Flow		-				-				-			REGION
16	Environmental Water Account Releases		-				-				-			PSA/DAU
17a	Conveyance Return Flows to Developed Supply - Urban		-				-				-			PSA/DAU
b	Conveyance Return Flows to Developed Supply - Ag		-				-				-			PSA/DAU
c	Conveyance Return Flows to Developed Supply - Managed Wetlands		-				-				-			PSA/DAU
18a	Conveyance Seepage - Urban		-				-				-			PSA/DAU
b	Conveyance Seepage - Ag		-				-				-			PSA/DAU
c	Conveyance Seepage - Managed Wetlands		-				-				-			PSA/DAU
19a	Recycled Water - Agriculture		-				-				-			PSA/DAU
b	Recycled Water - Urban		16.0				17.2				17.8			PSA/DAU
c	Recycled Water - Groundwater		-				-				-			PSA/DAU
20a	Return Flow to Developed Supply - Ag		-				-				-			PSA/DAU
b	Return Flow to Developed Supply - Wetlands		-				-				-			PSA/DAU
c	Return Flow to Developed Supply - Urban		145.4				161.0				211.9			PSA/DAU
21a	Deep Percolation of Applied Water - Ag		78.5				84.6				76.6			PSA/DAU
b	Deep Percolation of Applied Water - Wetlands		-				-				-			PSA/DAU
c	Deep Percolation of Applied Water - Urban		-				-				-			PSA/DAU
22a	Reuse of Return Flows within Region - Ag		119.9				132.3				135.3			PSA/DAU
b	Reuse of Return Flows within Region - Wetlands, Instream, W&S		-				-				-			PSA/DAU
24a	Return Flow for Delta Outflow - Ag		-				-				-			PSA/DAU
b	Return Flow for Delta Outflow - Wetlands, Instream, W&S		-				-				-			PSA/DAU
c	Return Flow for Delta Outflow - Urban Wastewater		-				-				-			PSA/DAU
25	Direct Diversions	N/A				N/A				N/A				PSA/DAU
26	Surface Water in Storage - Beg of Yr	580.8				585.4				566.9				PSA/DAU
27	Groundwater Extractions - Banked	-				-				-				PSA/DAU
28	Groundwater Extractions - Adjudicated	-				-				-				PSA/DAU
29	Groundwater Extractions - Unadjudicated	254.3				304.4				307.9				REGION
Withdrawals:	**In Thousand Acre-feet**													
23	Groundwater Subsurface Outflow	N/A				N/A				N/A				REGION
30	Surface Water Storage - End of Yr	566.3				566.9				568.3				PSA/DAU
31	Groundwater Recharge-Contract Banking		-14.7				-59.2				-8.9			PSA/DAU
32	Groundwater Recharge-Adjudicated Basins		-				-				-			PSA/DAU
33	Groundwater Recharge-Unadjudicated Basins		-				-				-			REGION
34a	Evaporation and Evapotranspiration from Native Vegetation				N/A				N/A				N/A	REGION
b	Evaporation and Evapotranspiration from Unirrigated Ag				N/A				N/A				N/A	REGION
35a	Evaporation from Lakes				1,555.5				1,552.5				1,552.4	REGION
b	Evaporation from Reservoirs				120.0				121.5				120.6	REGION
36	Ag Effective Precipitation on Irrigated Lands		-				-				-			REGION
37	Agricultural Use		3,570.5	3,372.1	3,372.0		3,732.4	3,515.5	3,515.4		3,663.6	3,451.7	3,451.7	PSA/DAU
38	Wetlands Use		31.6	31.6	31.6		30.2	30.2	30.2		29.6	29.6	29.6	PSA/DAU
39a	Urban Residential Use - Single Family - Interior		84.4				108.5				147.6			PSA/DAU
b	Urban Residential Use - Single Family - Exterior		121.7				119.8				90.4			PSA/DAU
c	Urban Residential Use - Multi-family - Interior		20.3				10.2				9.7			PSA/DAU
d	Urban Residential Use - Multi-family - Exterior		14.3				9.5				10.1			PSA/DAU
40	Urban Commercial Use		48.0				96.0				151.3			PSA/DAU
41	Urban Industrial Use		3.3				4.7				4.9			PSA/DAU
42	Urban Large Landscape		161.2				157.5				105.7			PSA/DAU
43	Urban Energy Production		76.7				76.7				76.7			PSA/DAU
44	Instream Flow		-	-	-		-		-		-	-	-	PSA/DAU
45	Required Delta Outflow		-	-	-		-		-		-	-	-	PSA/DAU
46	Wild & Scenic Rivers Use		-	-	-		-	-	-		-	-	-	PSA/DAU
47a	Evapotranspiration of Applied Water - Ag				2,466.1				2,617.9				2,594.8	PSA/DAU
b	Evapotranspiration of Applied Water - Managed Wetlands				31.6				30.2				29.6	PSA/DAU
c	Evapotranspiration of Applied Water - Urban				297.2				292.1				206.2	PSA/DAU
48	Evaporation and Evapotranspiration from Urban Wastewater				-				-				-	REGION
49	Return Flows Evaporation and Evapotranspiration - Ag				90.7				89.7				85.6	PSA/DAU
50	Urban Waste Water Produced	59.8				66.5				68.2				REGION
51a	Conveyance Evaporation and Evapotranspiration - Urban				37.1				24.3				18.9	PSA/DAU
b	Conveyance Evaporation and Evapotranspiration - Ag				64.0				64.0				64.0	PSA/DAU
c	Conveyance Evaporation and Evapotranspiration - Managed Wetlands				-				-				-	PSA/DAU
d	Conveyance Loss to Mexico				N/A				N/A				N/A	PSA/DAU
52a	Return Flows to Salt Sink - Ag				1,089.8				1,082.4				1,045.9	PSA/DAU
b	Return Flows to Salt Sink - Urban				189.2				196.1				198.9	PSA/DAU
c	Return Flows to Salt Sink - Wetlands				-				-				-	PSA/DAU
53	Remaining Natural Runoff - Flows to Salt Sink				-				-				-	REGION
54a	Outflow to Nevada				-				-				-	REGION
b	Outflow to Oregon				-				-				-	REGION
c	Outflow to Mexico				-				-				-	REGION
55	Regional Imports	5,142.6				5,449.4				5,192.8				REGION
56	Regional Exports	1,081.3				1,296.0				1,202.0				REGION
59	Groundwater Net Change in Storage	-57.6				-188.5				-200.7				REGION
60	Surface Water Net Change in Storage	-14.5				-18.5				1.4				REGION
61	Surface Water Total Available Storage	620.4				620.4				620.4				REGION

Colored spaces are where data belongs. N/A Data Not Available "-" Data Not Applicable "0" Null value

Table 11-7
Colorado River Region Water Use and Distribution of Dedicated Supplied

	1998			2000			2001		
	Applied Water Use	Net Water Use	Depletion	Applied Water Use	Net Water Use	Depletion	Applied Water Use	Net Water Use	Depletion
WATER USE									
Urban									
Large Landscape	161.2			157.5			105.7		
Commercial	48.0			96.0			151.3		
Industrial	3.3			4.7			4.9		
Energy Production	76.7			76.7			76.7		
Residential - Interior	104.7			118.7			157.3		
Residential - Exterior	136.0			129.3			100.5		
Evapotranspiration of Applied Water		297.2	297.2		292.1	292.1		206.2	206.2
Irrecoverable Losses		73.9	73.9		81.3	81.3		83.0	83.0
Outflow		122.9	122.9		129.0	129.0		130.4	130.4
Conveyance Losses - Applied Water	0.0			0.0			0.0		
Conveyance Losses - Evaporation		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Irrecoverable Losses		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Outflow		0.0	0.0		0.0	0.0		0.0	0.0
GW Recharge Applied Water	132.9			90.5			39.5		
GW Recharge Evap + Evapotranspiration		23.5	23.5		10.1	10.1		4.4	4.4
Total Urban Use	**662.8**	**517.5**	**517.5**	**673.4**	**512.5**	**512.5**	**635.9**	**424.0**	**424.0**
Agriculture									
On-Farm Applied Water	3,570.5			3,732.4			3,663.6		
Evapotranspiration of Applied Water		2,466.1	2,466.1		2,617.9	2,617.9		2,594.8	2,594.8
Irrecoverable Losses		90.7	90.7		89.7	89.7		85.6	85.6
Outflow		815.2	815.2		807.8	807.8		771.3	771.3
Conveyance Losses - Applied Water	338.6			338.6			338.6		
Conveyance Losses - Evaporation		64.0	64.0		64.0	64.0		64.0	64.0
Conveyance Losses - Irrecoverable Losses		167.6	167.6		167.6	167.6		167.6	167.6
Conveyance Losses - Outflow		107.0	107.0		107.0	107.0		107.0	107.0
GW Recharge Applied Water	0.0			0.0			0.0		
GW Recharge Evap + Evapotranspiration		0.0	0.0		0.0	0.0		0.0	0.0
Total Agricultural Use	**3,909.1**	**3,710.6**	**3,710.6**	**4,071.0**	**3,854.0**	**3,854.0**	**4,002.2**	**3,790.3**	**3,790.3**
Environmental									
Instream									
Applied Water	0.0			0.0			0.0		
Outflow		0.0	0.0		0.0	0.0		0.0	0.0
Wild & Scenic									
Applied Water	0.0			0.0			0.0		
Outflow		0.0	0.0		0.0	0.0		0.0	0.0
Required Delta Outflow									
Applied Water	0.0			0.0			0.0		
Outflow		0.0	0.0		0.0	0.0		0.0	0.0
Managed Wetlands									
Habitat Applied Water	31.6			30.2			29.6		
Evapotranspiration of Applied Water		31.6	31.6		30.2	30.2		29.6	29.6
Irrecoverable Losses		0.0	0.0		0.0	0.0		0.0	0.0
Outflow		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Applied Water	0.0			0.0			0.0		
Conveyance Losses - Evaporation		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Irrecoverable Losses		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Outflow		0.0	0.0		0.0	0.0		0.0	0.0
Total Managed Wetlands Use	31.6	31.6	31.6	30.2	30.2	30.2	29.6	29.6	29.6
Total Environmental Use	**31.6**	**31.6**	**31.6**	**30.2**	**30.2**	**30.2**	**29.6**	**29.6**	**29.6**
TOTAL USE AND LOSSES	**4,603.5**	**4,259.7**	**4,259.7**	**4,774.6**	**4,396.7**	**4,396.7**	**4,667.7**	**4,243.9**	**4,243.9**
DEDICATED WATER SUPPLIES									
Surface Water									
Local Deliveries	6.6	6.6	6.6	6.3	6.3	6.3	4.0	4.0	4.0
Local Imported Deliveries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Colorado River Deliveries	3,904.9	3,904.9	3,904.9	4,052.8	4,052.8	4,052.8	3,946.9	3,946.9	3,946.9
CVP Base and Project Deliveries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Federal Deliveries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SWP Deliveries	156.4	156.4	156.4	100.6	100.6	100.6	43.9	43.9	43.9
Required Environmental Instream Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Groundwater									
Net Withdrawal	175.8	175.8	175.8	219.8	219.8	219.8	231.3	231.3	231.3
Artificial Recharge	0.0			0.0			0.0		
Deep Percolation	78.5			84.6			76.6		
Reuse/Recycle									
Reuse Surface Water	265.3			293.3			347.2		
Recycled Water	16.0	16.0	16.0	17.2	17.2	17.2	17.8	17.8	17.8
TOTAL SUPPLIES	**4,603.5**	**4,259.7**	**4,259.7**	**4,774.6**	**4,396.7**	**4,396.7**	**4,667.7**	**4,243.9**	**4,243.9**
Balance = Use - Supplies	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*

Figure 11-2
Colorado River Region 1998 Flow Diagram
In Thousand Acre-Feet (TAF)

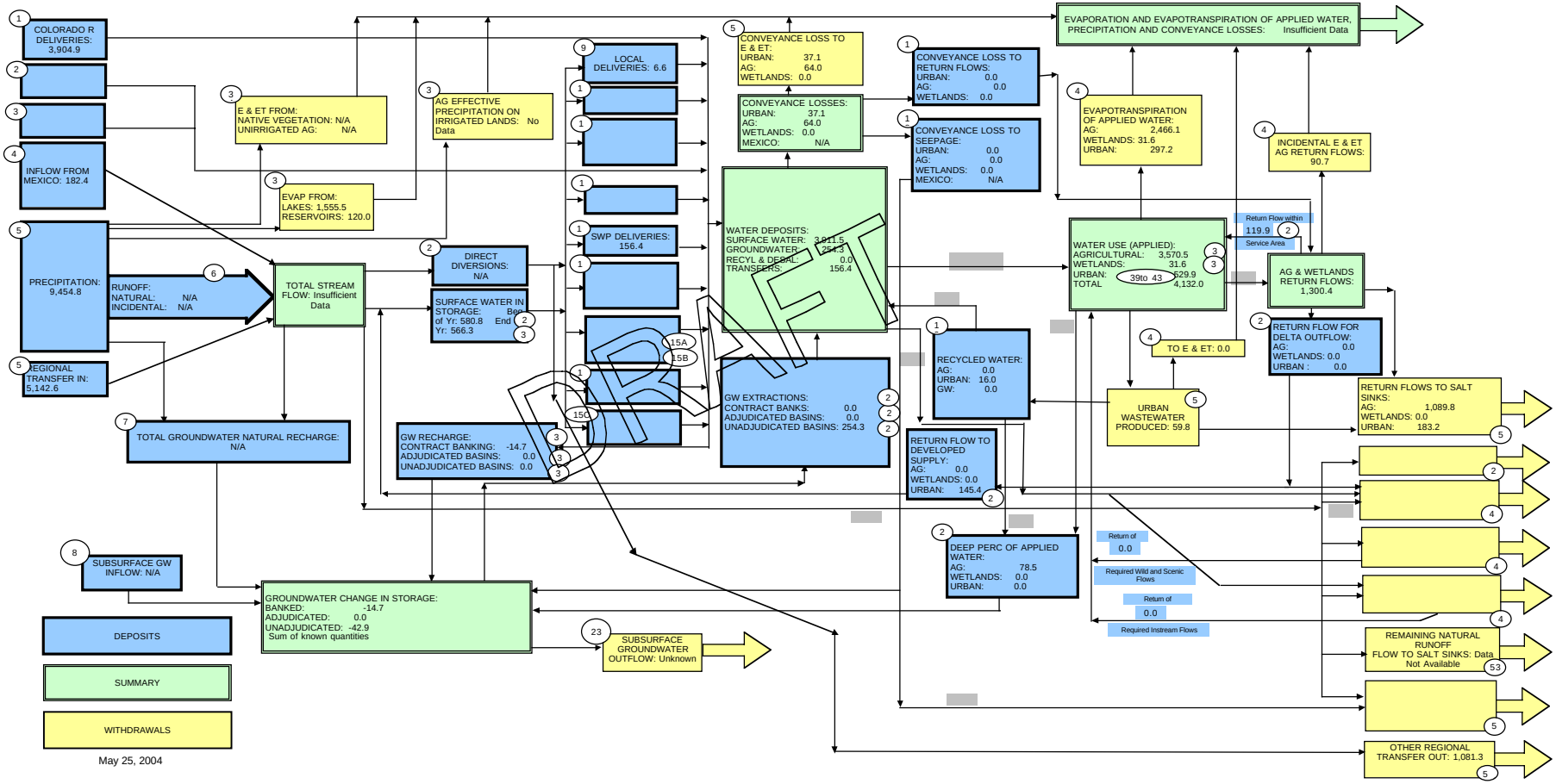


Figure 11-3
Colorado River Region 2000 Flow Diagram
In Thousand Acre-Feet (TAF)

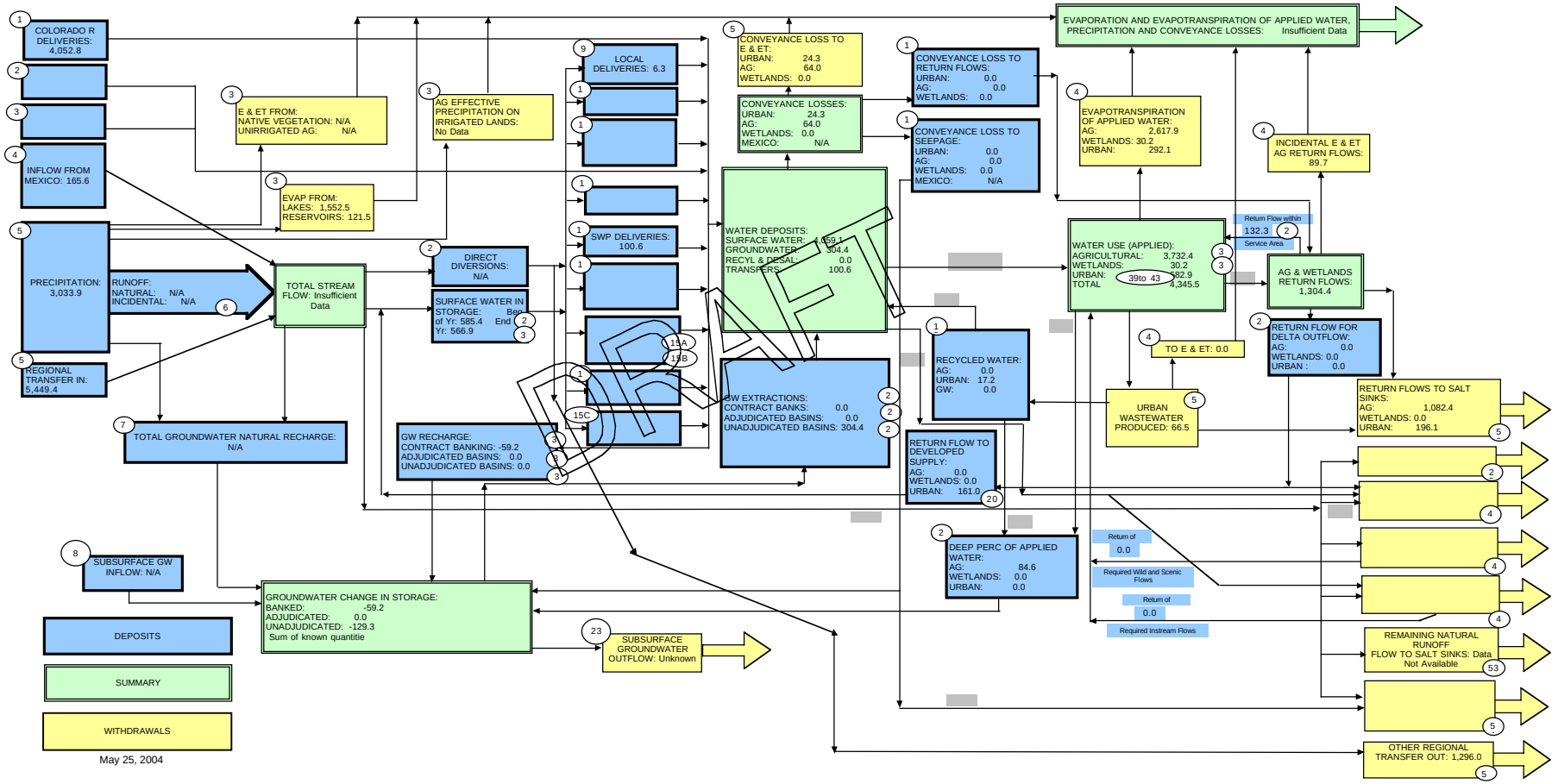


Figure 11-4
Colorado River Region 2001 Flow Diagram
In Thousand Acre-Feet (TAF)